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Special Issue: Social and Human Aspects of Cyber-Physical Systems

Guest Editorial: Social and Human Aspects of Cyber-Physical Systems

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Introduction

In the vision of Industry 4.0, the new industrial revolution is a revolution of cyber-physical systems, of which the Internet of Things forms a key foundation that has a great impact on the way people live, and the way businesses are organised. Cyber-physical systems are often considered feedback systems that integrate computation, networking, and physical processes, and more recently with 'human-in-the-loop' as one of the key research topics.

The advances in social computing have connected human-in-the-loop in cyber-social systems such as Facebook and Twitter, while their social-physical activities are supported by the cyber-physical systems on or near their bodies and in their interconnected environments. Cyber-physical systems become an integral part of social-cyber-physical systems (SCPS) that weave into the socio-technical fabric of human society. These hybrid systems, exhibiting both continuous (in physical and social spaces) and discrete (in cyberspaces) dynamic behaviour, give rise to not only new opportunities but also new challenges in designing products and services where human and technical aspects are massively intertwined. This Special Issue aims to present state-of-the-art research attempts and results on the topic of SCPS.

Identifying the humans involved

Realtime CPS applications in human-robot interaction, surveillance and security often work with low-resolution RGB-D images to identify the humans-in-the-loop. The paper "RGB-D face recognition using LBP with suitable feature dimension of depth image" by Abebe and Hwang presents a face recognition algorithm that works with the RGB-D images, using Local Binary Pattern feature descriptors with Multiclass Support Vector Machines for classification. The paper also shows the evidence of a satisfying performance with low computation requirement, which makes the algorithm feasible for realtime applications in the context of IoT and CPS.

Human brain in the loop

The paper "Architecture design for performing grasp-and-lift tasks in brain-machine-interface-based human-in-the-loop robotic system" by Chang *et al*., looks into the challenge of the grasp-and-lift tasks in human-in-the-loop robotic systems that can be a problem in an unstructured environment like urban search and rescue. To improve the communication between the human brain and machine intelligence, the paper proposes workflows with an Adaptive Boosting mechanism to enhance accuracy and robustness of intention and sensation signal classification, instead of the mechanism of the one-directional communication of a brain-controlled robot.

Mutual gaze between the system and the human

In human involved cyber-physical systems, humans often look at the system during the interaction, but what happens if the system looks together at something? Toyono and Osawa studied social facilitation by implementing gaze tracking with machine eyes. Their paper "Power of looking together: an analysis of social facilitation by Agent's mutual gaze" shows that the motivation of the human involved increases if the system (in their work, the agent) is following the gaze point of the human. It suggests that a joint gaze between the system and human would be useful in terms of social facilitation in human-in-the-loop cyber-physical systems.

Design for cyber-physical urban environment

Cities have become systems that combine cyber information and physical facilities, and how to design urban experience for such cities face new challenges. Fu *et al*., try to extend the practice of product -system service design in combination with public participation and the living lab method. They share their experiences with three design cases in their paper "Toward the participatory human-centred community an exploration of cyber-physical public design for urban experience." Using these design cases, they explore a cyber-physical public design model and its implications.

Integrated evaluation of human-machine interfaces

Cyber-physical systems with human-in-the-loop often engage the humans in interaction through the interfaces that integrate both software and hardware. Zeng *et al*., share their experience in integrated evaluation of such interfaces in the design process of electric automotive prototypes in their paper "Integrated evaluation of hardware and software interfaces for automotive human-machine interaction" in which an evaluation hierarchy helps guide the evaluation process.

Conclusion

The papers selected for this Special Issue cover a diversity of the social and human aspects of cyber-physical systems, with a flavour of human-robot and human-machine interaction. It is still an ambition to look into the social and humans aspects of cyber-physical systems at large that involve large-scale connectivity of the systems and ever-possible ubiquitous connectedness of humans.

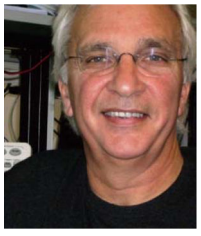
Guest Editor Biographies

Dr. Jun Hu is a Senior Member of ACM, an Associate Professor in Design Research on Social Computing at Department of Industrial Design, Eindhoven University of Technology (TU/e), a Guest Professor at Zhejiang University and Jiangnan University. He is currently the co-chair of the working group "Art and Entertainment" of IFIP (International Federation for Information Processing) TC14 (Technical Committee on Entertainment Computing). He is the coordinator of the TU/e DESIS Lab in the DESIS network (Design for Social Innovation

and Sustainability). He serves the editorial boards for several international journals.

Dr. Rong-Hao Liang is an Assistant Professor of Department of Industrial Design, Eindhoven University of Technology, The Netherlands. He received his Ph.D. degree in Computer Science and M.S. degree in Electrical Engineering from National Taiwan University, and found a technical startup, GaussToys Inc., in Taiwan. His research area is Human-Computer Interaction, with a specific focus on enabling technologies and techniques, such as tangible and wearable sensors, ubiquitous displays, and rapid prototyping tools, aiming at closing the gaps between the physical and the digital worlds. He is a member of the program committees of ACM TEI 2018, ACM UIST 2018, and the organizing committee of ACM MobileHCI 2019.

Prof. Dr. Chi-Sheng Shih is a Professor at the Graduate Institute of Networking and Multimedia, and Department of Computer Science and Information Engineering at National Taiwan University. He receives his PhD from University of Illinois at Urbana-Champaign, US in 2003, and his M.S. and B.S. from National Cheng Kung University, Tainan, Taiwan. His research interests include multi-dimension real-time resource allocation and real-time scheduling theory, requirement assignment and determination, resource allocation, cyber-physical systems, streaming computation, multi-robot collaboration, and middleware for Internet-of-Things. His works have been recognized by several awards, including RTSS Best Student Paper Award 2003, IEEE RTCSA Best Paper Award, IEEE RTAS Best Paper Award, ACM RACS Best Paper Award, and IEEE SC2 Best Paper Award 2016.



Prof. Dr. Andreu Catala is Professor in the Department of Automatic Control at the Technical University of Catalonia (UPC). Former Dean of the Engineering School of Vilanova i la Geltrú (UPC) (2000–06). Nowadays, Director of the Research Centre for Dependency Care and Autonomous Living (http://www.epsevg.upc.edu/cetpd/). Teaching activities in Artificial Intelligence Master and Automatic Control and Robotics Master related to Human Computer Interaction, Ambient Intelligence and Machine Learning. Chairman of the International Work Conference of Artificial Neural Networks. His research interests include Assistive Technologies, Artificial Intelligence, and Social Robotics. Spin Off promoter, SENSE4CARE. (http://www.sense4care.com/) Coordinator of international and national research projects, among them the European Thematic Network in Falls Prevention Intervention and Security (E-NOFALLS 2013-16). Member of the coordination team of the EIPAHA (Action Group A2 in Personalised HEALTH. Falls Prevention)

Dr. Lucio Marcenaro enjoys over 15 years experience in image and video sequence analysis, and authored about 100 technical papers related to signal and video processing for computer vision. An Electronic Engineering graduate from Genova University in 1999, he received his PhD in Computer Science and Electronic Engineering from University of Genova in 2003. From 2003 to 2010 he was CEO and development manager at TechnoAware srl. From March 2011, he became Assistant Professor in Telecommunications for the Faculty of Engineering at the Department of Electrical, Electronic, Telecommunications Engineering and Naval Architecture (DITEN) at the University of Genova where he teaches the courses of Pervasive Electronics and Computer Programming and Telematics Lab. He is the principal scientific and technical coordinator of the Ambient Awareness Lab (A2Lab), with TechnoAware srl.

Dr. Hirotaka Osawa is an Assistant Professor in University of Tsukuba. His research field is in human-agent interaction, particularly anthropomorphization of an object. His own research focuses on how human-like appearance and attitude improves interaction between a user and machines. He wants to create universal users interface experiences using our innate response to the world. His research interest is an improvement of today's complex household appliances. Dr. Osawa received his PhD in Engineering, MS and BS in Computer Science from Keio University.